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Application of atomic force microscopy to studying of aluminum nanopowder

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Present study reports a detailed investigation of aluminum nanopowder ALEX (ALuminum Electro-eXploded) using various atomic force microscopy methods, *i.e.*, Kelvin probe force microscopy, force modulation methods, AFM spectroscopy, and capacitance contrast method. Nowadays aluminum nanopowder is considered as highly promising component of energetic formulations due to its higher reactivity towards oxidation, incremented burning rate and combustion efficiency, shortened ignition delays and agglomerate burning time with respect to compositions containing micron-sized metal.

However, drawbacks of Al nanopowders include the lowered active metal content and high electrostatic discharge (ESD) sensitivity. Thermal analysis experiments revealed the active metal content to be 84 wt.% with the rest of material appeared to be an aluminum oxide cover.

Application of the above AFM methods enabled to not only build the particle size distribution, but also to map local properties such as hardness, surface potential, and volume distribution of capacity. The last two parameters are of the paramount importance to study the ESD-sensitivity for Al nanopowders and its compositions. The particle size distribution data were confirmed by laser diffractometry, and AFM-obtained microscopic properties were compared with existing macroscopic characteristics of ALEX powder.

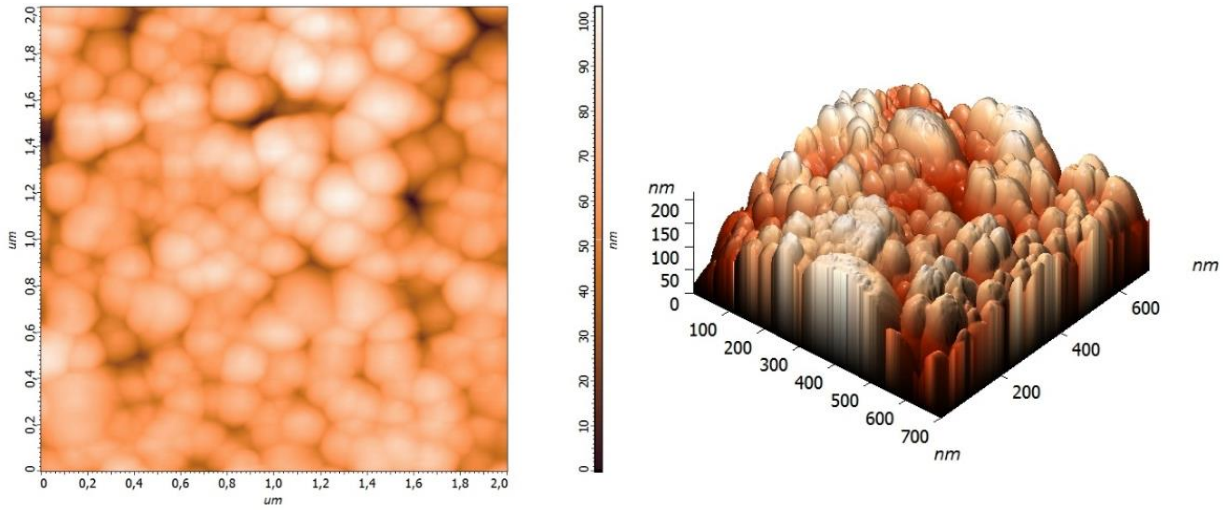

Figure 1. Contact (2D) and semicontact (3D) topography images of ALEX.